PRECISE MEASUREMENT STUDY - STAFF STUDY
(#11017)

1. PROBLEM:

To provide NPIC with a basis for further refinement in the efficiency and cost effectiveness of its mensuration procedures.

2. FACTS BEARING ON THE PROBLEM:

a. Many of the mensuration requirements levied on NPIC/TID call for micron accuracies.

b. Mensuration requirements in NPIC/PAG and IAD are often less stringent, but are of great volume, so that increased speed could be traded for less accuracy.

c. Reconnaissance photography is very different from cartographic photography. The reliability and repeatability of operator pointing on reconnaissance photography, with its complex geometrical distortions, has a great influence on the precision of measurements.

d. Photographic films are influenced by environment. Temperature and relative humidity cause physical changes in the film dimensions and various film bases differ in stability and strength. Various photographic bases and emulsions possess different properties and may react differently to environmental changes.

e. Great strides have been made in developing measuring engines, but available instruments have both advantages and disadvantages and a wide price range.

3. DISCUSSION:

a. Background - Rapid increases in the quantity and resolution of reconnaissance photography have resulted in increased demands for adequate mensuration equipment. Efforts to develop instruments to meet these demands have made it apparent that the operational components of NPIC need varying degrees of mensuration accuracy. Certain trade-offs might be acceptable, but there is no information available on cost effectiveness, the desirable trade-off between accuracy and speed, and the effects of dimensional changes in film.

Many times, the solution to one problem in the development of mensuration instruments has created new problems whose effect on mensuration accuracy and procedures must be established in turn. The

increased resolution of reconnaissance photography, combined with the extreme operating parameters, created a need for high magnification. This in turn required high-intensity illumination, which results in a new problem: the effect of heat on film. Increased requirements for reliable measurements have brought about new methods for film holddown, such as vacuum and air puck techniques. This in turn has raised questions as to the physical effects such constraints may have on the film.

b. Origin of Concept - The practices involved in making measurements on film imagery are repeatedly questioned, and TID and TDS personnel are frequently called upon to justify procedures. For example, the requirement for measuring in stereo on reconnaissance photography is often questioned because the cartographer finds that monoscopic measurements suffice on low-altitude vertical mapping photography. The cost of measurement accuracy is also frequently questioned: can dollar value be established for precision?

This study is intended to obtain objective answers to these and related questions and to supply information that will be used as a guide for the development of future mensuration capabilities.

c. Selection of Contractor - During the competitive Feasibility Studies [redacted] for a High Precision Stereo Comparator, a need arose for backup material to be used by the Technical Development Staff, to accurately evaluate the results of the studies. NPIC contracted with [redacted] on a time and materials basis [redacted] to undertake certain studies dealing with film comparator development criteria. These studies provided valuable information on laser metrology, building vibration effects, and fabrication materials. 50X1 50X1 50X1

[redacted] has submitted a new proposal for a two-part program. Phase I is a literature search and Phase II is an analysis and validation of effects on precise measurements. 50X1

d. Proposed Project - The proposed study calls for an expenditure of $45,112 in FY 1967. The results of the program will provide NPIC with an insight into: (1) the necessary accuracy for selected tasks; (2) the measuring engines required for these tasks; (3) the limits of operator pointing; and (4) the cost performance curves based on this data.

e. Phasing - The first phase of this program will be a short and intensive survey of the readily available data to be used for analysis and early decision. This will cost $8,840 and be completed in 2 months. Phase II will require approximately 9 months and cost $36,272. This phase will include extensive analysis and the experimentation necessary to provide the required information in critical areas. The relative emphasis of Phase II will be dependent on the findings of Phase I and the direction and requirements set forth by the Technical Representative.

f. Coordination - This project has been coordinated with RADC, GIMRADA, NRTSC, and the Bureau of Standards. Narrative statements describing this project have also been provided to DDS&T/ORD, DIA, AF, and Navy FFRD. If schedules allow, the results of a parallel project concerning a study of the P.I. operator will be used as an input for Phase II.

Mr. McCamy of the Metrology Group of the Bureau of Standards has reviewed this project. He agrees with the concept and concurs with this approach. He is also receptive to assisting as a technical representative for specialized parts and will do limited amount of travel on behalf of NPIC if it is requested.

4. CONCLUSIONS:

A large quantity of pertinent information is available in published literature on mensuration methods, but not codified. This should be made available to NPIC in a convenient package. Certain system and film criteria will have to be established by analysis and experiment.

This information will enable NPIC to establish standards for the development of future mensuration equipment.

5. RECOMMENDATIONS:

It is recommended that approval be granted to enter into a time and materials type R&D contract with [redacted] with funding of $45,112 for FY 1967. 50X1

6. REFERENCES AND ATTACHMENTS:

TAB A. Catalog Form

Attachment: [redacted] Proposal and NPIC Work Statement 50X1